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| 10/695,249 | 10/27/2003 | Valery M. Dubin | 42P16681 | 4353 |

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EXAMINER

LE, DUNG ANH

| ART UNIT | PAPER NUMBER |
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2818

DATE MAILED: 09/05/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

10/695,249

Applicant(s)

DUBIN ET AL.

Examiner

DUNG A. LE

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --
Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 30 June 2006.
2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-5, 8, 10, 12, 15--17, 27, 29 is/are pending in the application.
4a) Of the above claim(s) _____ is/are withdrawn from consideration.
5) ☐ Claim(s) _____ is/are allowed.
6) ☒ Claim(s) 1-5, 8, 10, 12, 15--17, 27, 29 is/are rejected.
7) ☐ Claim(s) _____ is/are objected to.
8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- 1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date _____.
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____

DETAILED ACTION

Claims 1, 12,15,16,27 are amended.

Claims 6,9,11,13-15,18-26 and 28 are canceled.

Claims 1-5,7-8,10,12,15-17,27 and 29 are pending.

Claim Objections

Claim 10 is objected, it depends from canceled claim 11.

Claim Rejections

Set of claims 1-5,7-8,10,12,15-17.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 1- 5 ,7- 8, 10, 12, 15 and 17 is rejected under 35 U.S.C. 103 (a) as being unpatentable over Kripesh et al. in view of Besser et al. (6444567 B1).

Kripesh et al. teach a method for making a semiconductor device comprising:

forming a conductive path 43 on a substrate (especially refer to figs. 4A-11 and related text) the conductive path made of copper;

depositing a metal more noble than copper 51/61/81 on the conductive path 51, from an aqueous solution by immersion plating [0031]; and

facilitating a diffusion ([0031], [0037] and [0046])of the metal more noble than copper into the conductive path, the metal more noble than copper having a low solubility to substantially diffuse into grain boundaries of the conductive path to significantly increase reliability of the conductive path.

Kripesh et al. do not teach the step of planarizing the conductive path after the facilitating to removed the deposited metal and a portion of the conductive path.

Besser et al. disclose planarizing the conductive path after the facilitating to removed the posited metal and a portion of the conductive path (Fig. 2 , col 11, lines 1-15 and related texts).

It would have been obvious to a person of ordinary skill in the art at the time the invention was made to planarizing the conductive path after the facilitating to removed the posited metal and a portion of the conductive path in Kripesh et al. 's method, in order to minimizing or substantially preventing electromigration therefrom may then be subjected to further "back-end" metallization processing, e.g., adherent formation thereon, as by damascene techniques, of at least one additional layer or strata of in-laid metallization.

Regarding claim 2, Kripesh teaches wherein the metal-metal more noble than copper comprises platinum [0030].

Regarding claim 3, Kripesh teaches wherein the metal is upper the metal more noble than copper comprise rhodium [see claim 10 and 54 of prior art].

Regarding claim 4, Kripesh teaches wherein forming the conductive path 43 comprises a damascene process.

Regarding claim 5, wherein the metal more noble than copper comprises gold [see claim 10 and 54 of prior art].

Regarding claim 7, Kripesh teaches wherein the metal more noble than copper comprises ruthenium [see claim 10 and 54 of prior art].

Regarding claim 8, Kripesh teaches wherein metal more noble than copper comprises osmium [see claim 10 and 54 of prior art].

Regarding claim 10, Kripesh teaches wherein the metal more noble than copper comprises iridium [see claim 10 and 54 of prior art].

Regarding claim 15, Kripesh teaches wherein facilitating diffusion of the second material comprises heat treating [0037] the conductive path 43 having the deposited metal more noble the copper 51.

Regarding claim 17, Kripesh teaches wherein the conductive path 43 comprises at least of one of a conductive line and a conductive interconnect.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claim 16 is rejected under 35 U.S.C. 103 (a) as being unpatentable over Kripesh et al. in view of Besser et al. and further in view of Sinha et al. (2004/0157433 A1) or the following remark.

Kripesh et al. in view of Besser teaches the claimed invention as applied to claim 1 and 15 including a heat treatment except for heat treating the conductive path comprises annealing the conductive path to substantially diffuse the metal more noble the copper to the grain boundaries within the copper, the temperature and time based at least in part on the copper and the metal more noble the copper as cited in current claim 16.

However, it would have been obvious to one having ordinary skill in the art making semiconductor device to determine the workable or optimal value for heat treating the conductive path comprises annealing the conductive path to substantially diffuse the metal more noble the copper to the grain boundaries within the copper, the temperature and time based at least in part on the copper

and the metal more noble the copper through routine experimentation and optimization to optimal device performance.

Set of claims 27 and 29

Claims 27 and 29 are rejected under 35 U.S.C. 103 (a) as being unpatentable over Kripesh et al. in view of Han et al. (6,924,234 B2) and furthering view of Besser et al.

Kripesh et al. teach a method for making a semiconductor device comprising:

forming a conductive path 43 on a substrate, the conductive path made of a first material;

depositing a second material 51/61/81 on the conductive path; and

facilitating a diffusion [0031] [0037] and 0046] of the second material into the conductive path, the second material having a predetermined solubility to substantially diffuse to at least one of an interface and grain boundaries within the first material to significantly increase reliability of the conductive path.

Kripesh et al. does not teach removing an oxide from the conductive path by etching the conductive path with a medium having a mildly acidic or mildly basic solution and planarizing the conductive path after the facilitating to removed the posited metal and a portion of the conductive path.

Han et al. teach removing an oxide from the conductive path by etching the conductive path with a medium having a mildly acidic or mildly basic solution (figs. 2E-2G and col 4, lines 1-17).

It would have been obvious to a person of ordinary skill in the art at the time the invention was made to remove an oxide from the conductive path by etching the conductive path with a medium having a mildly acidic or mildly basic solution in Kripesh 's method in order to improve planarization, while mitigating scratched during fabricating and improvement (col 2, line 35-40 and col 3, lines 10-15).

Besser et al. disclose planarizing the conductive path after the facilitating to removed the posited metal and a portion of the conductive path (Fig. 2 , col 11, lines 1-15 and related texts).

It would have been obvious to a person of ordinary skill in the art at the time the invention was made to planar the conductive path after the facilitating to removed the posited metal and a portion of the conductive path in Kripesh et al. and Han 's method, in order to minimizing or substantially preventing electromigration therefrom may then be subjected to further "back-end"

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metallization processing, e.g., adherent formation thereon, as by damascene techniques, of at least one additional layer or strata of in-laid metallization.

Regarding claim 29, Kripesh (claim 10 on page 14) discloses the second material further comprises at least one of silver, gold, palladium, ruthenium, rhodium, osmium, iridium, and platinum.

When responding to the office action, Applicants' are advice to provide the examiner with the line numbers and page numbers in the application and/or references cited to assist the examiner to locate the appropriate paragraphs.

A shortened statutory period for response to this action is set to expire 3 (three) months and 0 (zero) day from the day of this letter. Failure to respond within the period for response will cause the application to become abandoned (see M.P.E.P 710.02(b)).

Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire **THREE MONTHS** from the mailing date of this action. In the event a first reply is filed within **TWO MONTHS** of the mailing date of this final action and the advisory action is not mailed until after the end of the **THREE-MONTH** shortened

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statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Dung A. Le whose telephone number is (571) 272-1784. The examiner can normally be reached on Monday-Tuesday and Thursday 6:00am-4:00 pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Matthew Smith can be reached on (571) 272-1787. The central fax phone numbers for the organization where this application or proceeding is assigned are (571)272-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR

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only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

DUNG A. LE
Primary Examiner
Art Unit 2818

